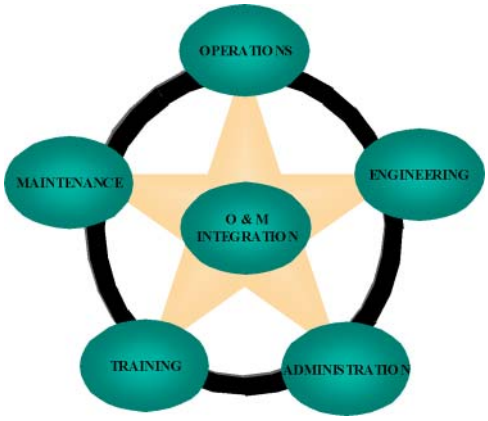
Chapter 3 O&M Management

3.1 Introduction

O&M management is a critical component of the overall program. The management function should bind the distinct parts of the program into a cohesive entity. From our experience, the overall program should contain five very distinct functions making up the organization: **O**perations, **M**aintenance, **E**ngineering, **T**raining, and **A**dministration—OMETA.

Beyond establishing and facilitating the OMETA links, O&M managers have the responsibility of interfacing with other department managers and making their case for ever-shrinking budgets. Their roles also include project implementation functions as well as the need to maintain persistence of the program and its goals.



3.2 Developing the Structure

Five well-defined elements of an effective O&M program include those presented above in the OMETA concept (Meador 1995). While these elements, Operations, Maintenance, Engineering, Training, and Administration, form the basis for a solid O&M organization, the key lies in the well-defined functions each brings and the linkages between organizations. A subset of the roles and responsibilities for each of the elements is presented below; further information is found in Meador (1995).

Operations

- ***Administration*** – To ensure effective implementation and control of operation activities.
- ***Conduct of Operations*** – To ensure efficient, safe, and reliable process operations.
- ***Equipment Status Control*** – To be cognizant of status of all equipment.
- ***Operator Knowledge and Performance*** – To ensure that operator knowledge and performance will support safe and reliable plant operation.

Maintenance

- ***Administration*** – To ensure effective implementation and control of maintenance activities.
- ***Work Control System*** – To control the performance of maintenance in an efficient and safe manner such that economical, safe, and reliable plant operation is optimized.
- ***Conduct of Maintenance*** – To conduct maintenance in a safe and efficient manner.
- ***Preventive Maintenance*** – To contribute to optimum performance and reliability of plant systems and equipment.

- ***Maintenance Procedures and Documentation*** – To provide directions, when appropriate, for the performance of work and to ensure that maintenance is performed safely and efficiently.

Engineering Support

- ***Engineering Support Organization and Administration*** – To ensure effective implementation and control of technical support.
- ***Equipment Modifications*** – To ensure proper design, review, control, implementation, and documentation of equipment design changes in a timely manner.
- ***Equipment Performance Monitoring*** – To perform monitoring activities that optimize equipment reliability and efficiency.
- ***Engineering Support Procedures and Documentation*** – To ensure that engineer support procedures and documents provide appropriate direction and that they support the efficiency and safe operations of the equipment.

Training

- ***Administration*** – To ensure effective implementation and control of training activities.
- ***General Employee Training*** – To ensure that plant personnel have a basic understanding of their responsibilities and safe work practices and have the knowledge and practical abilities necessary to operate the plant safely and reliably.
- ***Training Facilities and Equipment*** – To ensure the training facilities, equipment, and materials effectively support training activities.
- ***Operator Training*** – To develop and improve the knowledge and skills necessary to perform assigned job functions.
- ***Maintenance Training*** – To develop and improve the knowledge and skills necessary to perform assigned job functions.

Administration

- ***Organization and Administration*** – To establish and ensure effective implementation of policies and the planning and control of equipment activities.
- ***Management Objectives*** – To formulate and utilize formal management objectives to improve equipment performance.
- ***Management Assessment*** – To monitor and assess station activities to improve all aspects of equipment performance.
- ***Personnel Planning and Qualification*** – To ensure that positions are filled with highly qualified individuals.
- ***Industrial Safety*** – To achieve a high degree of personnel and public safety.

3.3 Obtain Management Support

Federal O&M managers need to obtain full support from their management structure in order to carry out an effective maintenance program. A good way to start is by establishing a written

maintenance plan and obtaining upper management approval. Such a management-supported program is very important because it allows necessary activities to be scheduled with the same priority as other management actions. Approaching O&M by equating it with increased productivity, energy efficiency, safety, and customer satisfaction is one way to gain management attention and support.

When designing management reports, the critical metrics used by each system should be compared with a base period. For example, compare monthly energy use against the same month for the prior year, or against the same month in a particular base year (for example, 1985). If efficiency standards for a particular system are available, compare your system's performance against that standard as well. The point of such comparisons in management reports is not to assign blame for poor maintenance and inefficient systems, but rather to motivate efficiency improvement through improved maintenance.

3.4 Measuring the Quality of Your O&M Program

Traditional thinking in the O&M field focused on a single metric, reliability, for program evaluation. Every O&M manager wants a reliable facility; however, this metric alone is not enough to evaluate or build a successful O&M program.

Beyond reliability, O&M managers need to be responsible for controlling costs, evaluating and implementing new technologies, tracking and reporting on health and safety issues, and expanding their program. To support these activities, the O&M manager must be aware of the various indicators that can be used to measure the quality or effectiveness of the O&M program. Not only are these metrics useful in assessing effectiveness, but also useful in cost justification of equipment purchases, program modifications, and staff hiring.

Below are a number of metrics that can be used to evaluate an O&M program. Not all of these metrics can be used in all situations; however, a program should use of as many metrics as possible to better define deficiencies and, most importantly, publicize successes.

- ***Capacity factor*** – Relates actual plant or equipment operation to the full-capacity operation of the plant or equipment. This is a measure of actual operation compared to full-utilization operation.
- ***Work orders generated/closed out*** – Tracking of work orders generated and completed (closed out) over time allows the manager to better understand workloads and better schedule staff.
- ***Backlog of corrective maintenance*** – An indicator of workload issues and effectiveness of preventive/predictive maintenance programs.
- ***Safety record*** – Commonly tracked either by number of loss-of-time incidents or total number of reportable incidents. Useful in getting an overall safety picture.
- ***Energy use*** – A key indicator of equipment performance, level of efficiency achieved, and possible degradation.
- ***Inventory control*** – An accurate accounting of spare parts can be an important element in controlling costs. A monthly reconciliation of inventory "on the books" and "on the shelves" can provide a good measure of your cost control practices.
- ***Overtime worked*** – Weekly or monthly hours of overtime worked has workload, scheduling, and economic implications.

- ***Environmental record*** – Tracking of discharge levels (air and water) and non-compliance situations.
- ***Absentee rate*** – A high or varying absentee rate can be a signal of low worker morale and should be tracked. In addition, a high absentee rate can have a significant economic impact.
- ***Staff turnover*** – High turnover rates are also a sign of low worker morale. Significant costs are incurred in the hiring and training of new staff. Other costs include those associated with errors made by newly hired personnel that normally would not have been made by experienced staff.

3.5 Selling O&M to Management

To successfully interest management in O&M activities, O&M managers need to be fluent in the language spoken by management. Projects and proposals brought forth to management need to stand on their own merits and be competitive with other funding requests. While evaluation criteria may differ, generally some level of economic criteria will be used. O&M managers need to have a working knowledge of economic metrics such as:

- ***Simple payback*** – The ratio of total installed cost to first-year savings.
- ***Return on investment*** – The ratio of the income or savings generated to the overall investment.
- ***Net present value*** – Represents the present worth of future cash flows minus the initial cost of the project.
- ***Life-cycle cost*** – The present worth of all costs associated with a project.

Life-Cycle Cost Training

The Basic LCC Workshop takes participants through the steps of an LCC analysis, explains the underlying theory, and integrates it with the FEMP criteria. The second classroom course, the Project-Oriented LCC Workshop, builds on the basic workshop and focuses on the application of the methodology to more complex issues in LCC analysis.

For more information: http://www.eere.energy.gov/femp/services/training.cfm

FEMP offers life-cycle cost training along with its Building Life-Cycle Cost (BLCC) computer program at various locations during the year – see Appendix B for the FEMP training contacts.

3.6 Program Implementation

Developing or enhancing an O&M program requires patience and persistence. Guidelines for initiating a new O&M project will vary with agency and management situation; however, some steps to consider are presented below:

- ***Start small*** – Choose a project that is manageable and can be completed in a short period of time, 6 months to 1 year.
- ***Select troubled equipment*** – Choose a project that has visibility because of a problematic history.
- ***Minimize risk*** – Choose a project that will provide immediate and positive results. This project needs to be successful, and therefore, the risk of failure should be minimal.

- ***Keep accurate records*** – This project needs to stand on its own merits. Accurate, if not conservative, records are critical to compare before and after results.
- ***Tout the success*** – When you are successful, this needs to be shared with those involved and with management. Consider developing a "wall of accomplishment" and locate it in a place where management will take notice.
- ***Build off this success*** – Generate the success, acknowledge those involved, publicize it, and then request more money/time/resources for the next project.

3.7 Program Persistence

A healthy O&M program is growing, not always in staff but in responsibility, capability, and accomplishment. O&M management must be vigilant in highlighting the capabilities and accomplishments of their O&M staff.

Finally, to be sustainable, an O&M program must be visible beyond the O&M management. Persistence in facilitating the OMETA linkages and relationships enables heightened visibility of the O&M program within other organizations.

3.8 O&M Contracting

Approximately 40% of all non-residential buildings contract maintenance service for heating, ventilation, and air conditioning (HVAC) equipment (PECI 1997). Discussions with federal building mangers and organizations indicate this value is significantly higher in the federal sector, and the trend is toward increased reliance on contracted services.

In the O&M service industry, there is a wide variety of service contract types ranging from full-coverage contracts to individual equipment contracts to simple inspection contracts. In a relatively new type of O&M contract, called End-Use or End-Result contracting, the O&M contractor not only takes over all operation of the equipment, but also all operational risk. In this case, the contractor agrees to provide a certain level of comfort (space temperature, for instance) and then is compensated based on how well this is achieved.

From discussions with federal sector O&M personnel, the predominant contract type is the full-coverage contract (also referred to as the whole-building contract). Typical full-coverage contract terms vary between 1 and 5 years and usually include options for out-years.

Upon review of several sample O&M contracts used in the federal sector, it is clear that some degree of standardization has taken place. For better or worse, some of these contracts contain a high degree of "boiler plate." While this can make the contract very easy to implement, and somewhat uniform across government agencies, the lack of site specificity can make the contract ambiguous and open to contractor interpretation often to the government's disadvantage.

When considering the use of an O&M contract, it is important that a plan be developed to select, contract with, and manage this contract. In its guide, titled *Operation and Maintenance Service Contracts* (PECI 1997), Portland Energy Conservation, Inc. did a particularly good job in presenting steps and actions to think about when considering an O&M contract. A summary of these steps are provided below.

Steps to Think About When Considering an O&M Contract

- Develop objectives for an O&M service contract, such as:
  - Provide maximum comfort for building occupants.
  - Improve operating efficiency of mechanical plant (boilers, chillers, cooling towers, etc.).
  - Apply preventive maintenance procedures to reduce chances of premature equipment failures.
  - Provide for periodic inspection of building systems to avoid emergency breakdown situations.
- Develop and apply a screening process. The screening process involves developing a series of questions specific to your site and expectations. The same set of questions should be asked to perspective contractors and their responses should be rated.
- Select two to four potential contractors and obtain initial proposals based on each contractor's building assessments. During the contractors' assessment process, communicate the objectives and expectations for the O&M service contract and allow each contractor to study the building documentation.
- Develop the major contract requirements using the contractors' initial proposals. Make sure to include the requirements for documentation and reporting. Contract requirements may also be developed by competent in-house staff or a third party.
- Obtain final bids from the potential contractors based on the owner-developed requirements.
- Select the contractor and develop the final contract language and service plan.
- Manage and oversee the contracts and documentation.
  - Periodically review the entire contract. Build in a feedback process.

The ability of federal agencies to adopt the PECI-recommended steps will vary. Still, these steps do provide a number of good ideas that should be considered for incorporation into federal maintenance contracts procurements.

3.8.1 Contract Incentives

An approach targeting energy savings through mechanical/electrical (energy consuming) O&M contracts is called contract incentives. This approach rewards contractors for energy savings realized for completing actions that are over and above the stated contract requirements.

Many contracts for O&M of federal building mechanical/electrical (energy consuming) systems are written in a prescriptive format where the contractor is required to complete specifically noted actions in order to satisfy the contract terms. There are two significant shortcomings to this approach:

- The contractor is required to complete only those actions specifically called out, but is not responsible for actions not included in the contract even if these actions can save energy, improve building operations, extend equipment life, and be accomplished with minimal additional effort. Also, this approach assumes that the building equipment and maintenance lists are complete.

- The burden to verifying successful completion of work under the contract rests with the contracting officer. While contracts typically contain contractor reporting requirements and methods to randomly verify work completion, building O&M contracts tend to be very large, complex, and difficult to enforce.

One possible method to address these shortcomings is to apply a provision of the Federal Acquisition Regulations (FAR), Subpart 16.404 – Fixed-Price with Award Fees, which allows for contractors to receive a portion of the savings realized from actions initiated on their part that are seen as additional to the original contract:

Subpart 16.404 — Fixed-Price Contracts With Award Fees.

(a) Award-fee provisions may be used in fixed-price contracts when the Government wishes to motivate a contractor and other incentives cannot be used because contractor performance cannot be measured objectively. Such contracts shall —

  (1) Establish a fixed price (including normal profit) for the effort. This price will be paid for satisfactory contract performance. Award fee earned (if any) will be paid in addition to that fixed price; and

  (2) Provide for periodic evaluation of the contractor's performance against an award-fee plan.

(b) A solicitation contemplating award of a fixed-price contract with award fee shall not be issued unless the following conditions exist:

  (1) The administrative costs of conducting award-fee evaluations are not expected to exceed the expected benefits;

  (2) Procedures have been established for conducting the award-fee evaluation;

  (3) The award-fee board has been established; and

  (4) An individual above the level of the contracting officer approved the fixed-price-award-fee incentive.

Applying this approach to building mechanical systems O&M contracts, contractor initiated measures would be limited to those that

- require little or no capital investment,
- can recoup implementation costs over the remaining current term, and
- allow results to be verified or agreed upon by the government and the contractor.

Under this approach, the contractor bears the risk associated with recovering any investment and a portion of the savings.

The General Services Administration (GSA) has inserted into many of its mechanical services contracts a voluntary provision titled Energy Conservation Award Fee (ECAF), which allows contractors and sites to pursue such an approach for O&M savings incentives. The ECAF model language provides for the following:

An energy use baseline will be furnished upon request and be provided by the Government to the contractor. The baseline will show the 3-year rolling monthly average electric and natural gas use prior to contract award.

- The Government will calculate the monthly electric savings as the difference between the monthly energy bill and the corresponding baseline period.
- The ECAF will be calculated by multiplying the energy savings by the monthly average cost per kilowatt-hour of electricity.
- All other contract provisions must be satisfied to qualify for award.
- The Government can adjust the ECAF for operational factors affecting energy use such as fluctuations in occupant density, building use changes, and when major equipment is not operational.

Individual sites are able to adapt the model GSA language to best suit their needs (e.g., including natural gas savings incentives). Other agencies are free to adopt this approach as well since the provisions of the FAR apply across the federal government.

Energy savings opportunities will vary by building and by the structure of the contract incentives arrangement. Some questions to address when developing a site specific incentives plan are:

- Will metered data be required or can energy savings be stipulated?
- Are buildings metered individually for energy use or do multiple buildings share a master meter?
- Will the baseline be fixed for the duration of the contract or will the baseline reset during the contract period?
- What energy savings are eligible for performance incentives? Are water savings also eligible for performance incentives?
- What administrative process will be used to monitor work and determine savings? Note that overly rigorous submittal, approval, justification, and calculation processes will discourage contractor participation.

Since the contract incentives approach is best suited for low cost, quick payback measures, O&M contractors should consider recommissioning/value recommissioning actions as discussed in Chapter 7.

An added benefit from the contract incentives process is that resulting operations and energy efficiency improvements can be incorporated into the O&M services contract during the next contract renewal or re-competition since (a) the needed actions are now identified, and (b) the value of the actions is known to the government.

3.8.2 Model Contract Language

Contracts being re-competed offer an opportunity to replace dated and often ambiguous boilerplate maintenance contract clauses with model contract clauses that make use of current best practices including predictive maintenance technologies such as infrared thermography, ultrasonics, and vibration analysis. These increased and updated requirements will result in increased award fees as current boilerplate clauses tend to emphasize only a preventive maintenance approach.

Examples of model contract language in the federal facilities sector are difficult to locate. The National Aeronautics and Space Administration (NASA) has developed a series of Guide Performance Work Statements that allows for the incorporation of many of the current O&M best practices including the use of predictive testing and inspection. The NASA O&M contracting approach has

become more outcome-based with an emphasis on results and outcomes instead of relying on the traditional performance-based approach where work requirements are specified. The family of NASA documents for these performance based contracts is available at http://www.hq.nasa.gov/office/codej/codejx/jxdocuments.htm#mtdocs, under the section heading "NASA Guide Performance Work Statements (GPWS)":

- (NASA 1997a) *The Guide Performance Work Statement for Center/Installation Operation Support Services*, Section C, contains the complete (unedited) GPWS. Of particular interest are the following subsections:
    - C.12, General Requirements and Procedures for Recurring Work,
    - C.15, Heating, Ventilation, Air Conditioning, Refrigeration, and Compressed Air Systems Maintenance and Repair,
    - C.16, High and Low Voltage Electrical Distribution Systems Maintenance and Repair,
    - C.17, Central Heating Plant Generation and Distribution Systems Operation, Maintenance and Repair, and
    - C.23, Potable and Industrial Water Systems Operation, Maintenance, and Repair.
- The *User's Guide for Preparing Performance Guide Work Statements for Center Operations Support Services* states that predictive testing and inspection is treated just like preventive maintenance in that it is performed and inspected on a regular basis (NASA 1997b).
- "Guide Performance Work Statement for Subsection 32 – Energy/Water Conservation Management Services" calls for contractors to serve as the site energy and water conservation program managers. Included in this section are various O&M functions including meter reading, audits, utility bill verification, leak detection, EMCS operation and repair, and commissioning (NASA 1999).

3.9 References

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